

**PHYTOTOXICOLOGY MOSS BAG,
VEGETATION AND SOIL SURVEYS IN
THE VICINITY OF THE IVACO METAL
RECYCLING PLANT IN LONGUEUIL
TOWNSHIP NEAR L'ORIGNAL**

May through November, 1991

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**Phytotoxicology Moss Bag, Vegetation, and Soil Surveys in the Vicinity
of the IVACO Metal Recycling Plant in Longueuil Township near L'Orignal
- May through November, 1991**

Introduction

During 1991, moss bag, vegetation and soil surveys were conducted by the Phytotoxicology Section, in conjunction with MOE Cornwall staff, in the vicinity of the IVACO metal recycling plant in Longueuil Township near L'Orignal. Since 1980, several Phytotoxicology assessment surveys have been conducted to assess the status of metal emissions from IVACO. The surveys were requested by the MOE Southeast Region.

Description of Phytotoxicology Surveys

Moss Bag Survey (May to November, 1991)

On May 13, 1991, moss bags were placed at the same sites (1 to 12) as in May 1986, with two exceptions. Site 12 was relocated across the road from the original site and Site 2 was moved slightly farther away from the railroad. The moss sites were situated at increasing distances to the north (N), south (S), east (E) and west (W) of IVACO (Figure 5). At each site, a single moss bag was placed at a height of about 3 meters on a telephone or hydro pole. The moss bags were replaced approximately every 30 days through to mid-November by Mr. G. Murphy, MOE Cornwall. The exchange dates and corresponding exposure intervals are shown in Table 1 below.

Table 1: Moss Bag Exchange Program - 1991

Exposure Period No.	First Day	Last Day	No. of Days
1	May 13	June 12	30
2	June 12	July 12	31
3	July 12	Aug. 12	31
4	Aug. 12	Sept. 12	31
5	Sept. 12	Oct. 11	30
6	Oct. 11	Nov. 12	32

The moss bags removed from the poles at the end of each exposure period were placed in separate paper bags which were labelled by site number and dated. At the end of each exposure period, a non-exposed moss bag (blank) from the same batch as the exposed bags was included for analysis, except on one occasion. The moss bags were subsequently delivered by courier to the Phytotoxicology Section for processing.

Previous moss bag surveys were conducted during October 1984 to April 1985, during May 1986 to April 1987 and during July 1987 to January 1988.

Maple Foliage and Soil Sampling (August 20, 1991)

On August 20, 1991, duplicate samples of maple foliage and surface soil (depth 0-5 cm) were collected using standard sampling techniques at 10 residential sites (1, 4, 6, 8, 9, 10, 11, 12, 19, 29), including 2 park sites (8, 12), where sampling was conducted in previous years. These sites are the same as those used in the 1987 soil survey. Park Site 8a (new in 1991) also was sampled (see Figure 6). Tree foliage and soil samples were both collected from the same property, except at Site 12. From the Site 12 area, soil was sampled in the park, while maple foliage was sampled on a neighbouring residential property. All maple foliage was collected from middle branches that were facing the IVACO plant.

Previous maple foliage (F) and/or soil (S) sampling had been conducted in the IVACO survey area in 1980 (F,S); 1981 (F); 1983 (F); 1984 (F,S); 1986 (F) and 1987 (S).

Sample Processing and Analysis

All samples (moss bags, foliage, soil) were submitted to the Phytotoxicology Section Processing Laboratory. Here, the samples were dried, ground and stored in glass jars. They were then submitted to the MOE Laboratory Services Branch for analysis of aluminum (Al), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), molybdenum (Mo), nickel (Ni), sodium (Na), strontium (Sr), vanadium (V) and zinc (Zn).

Analytical Results

Moss Bag Results

The moss bag analytical results for the six monthly exposures between May and November (1991) are summarized in Tables 2 to 15. Minimum and maximum concentrations and the six-month (May-November) site means for each metal are compared between sites close to IVACO and those more remote. The data have not been standardized for a 30 day exposure period. The Phytotoxicology Upper Limit of Normal (ULN) guidelines are also shown (for elements with a ULN).

Results for Elements with ULN Guideline(s)

Upper limit of Normal (ULN) guidelines for moss have been established for all elements except Mn, Mo, Na, Sr and V. In the case of Cr and Co, only an urban ULN has been established. The data show that only the highest concentrations of Cr, Cu, Fe, Pb and Zn were in excess of the ULNs, an indication that these were the primary metals emitted

from IVACO during the study period. The moss bag sites close to IVACO (less than 1000 m) generally had higher concentrations of these metals than more remote sites (greater than 1750 m), a further indication that IVACO is an emission source of Cr, Cu, Fe, Pb and Zn. Of these metals, mean concentrations of Fe and Zn at sites close to IVACO were increased by the largest degree compared to both the more remote site means and the baseline (blank) means. The Fe mean of the seven close sites (1169 ppm) was 429 ppm higher than the baseline mean (740 ppm), while the Zn mean of the close sites (157 ppm) was increased above the baseline mean (42 ppm) by 115 ppm.

The ULN guidelines for Cr, Cu, Fe, Pb and Zn were exceeded most frequently at Site 1 (near NE corner of IVACO), Site 3 (S perimeter), Site 9 (near NW corner) and/or Site 12 (near SE corner). These ULNs also were exceeded occasionally at Site 2 (near E perimeter) and Site 7 (near N perimeter).

A few remote sites also occasionally exceeded the rural ULNs for Cu, Pb and Ni (Tables 6, 8 and 11). However, because of the distance and the lack of a consistent contaminant gradient at the remote sites, these elevated values were not related to IVACO.

The 7 ppm Cr ULN (urban) was marginally exceeded only on two occasions at Sites 1, 3 and 7 (range 8-11 ppm, Table 4). Although Fe showed the greatest increase above baseline levels, the rural ULN (1700 ppm) was marginally exceeded only on a single occasion at Site 3 (2200 ppm, Table 7). These results suggest that IVACO was a minor source of these metals during the study period.

IVACO emissions appeared to be a more consistent source of Cu, Pb and Zn (particularly Zn) than of other metals, as the rural ULNs for these metals were exceeded at three sites (1, 9 and 12) during most exposures. At sites close to IVACO, the rural ULNs for Cu and Pb were each exceeded a total of 13 times, while the rural Zn ULN was exceeded 24 times (Tables 6, 8 and 15, respectively). However, in the case of Cu, the two highest six-month mean concentrations of 10 and 16 ppm were only marginally elevated (rural ULN 8 ppm). With Pb, only one site had a six-month mean (41 ppm) that was marginally elevated (rural ULN 35 ppm). In the case of Zn, five of the seven moss sites close to IVACO had a six-month mean (range 138-273 ppm) that was greater than the rural ULN (100 ppm)). However, none of the moss samples were found to have a Cu, Pb or Zn concentration that exceeded the urban ULNs (Cu 60 ppm, Pb 200 ppm, Zn 800 ppm). This is an indication that even though IVACO was a consistent source of these metals during the study period, the environmental significance of the Cu, Pb and Zn emissions was relatively minor in regards to contamination of the terrestrial environment.

Table 16 compares the 1991 moss bag Cr, Cu, Fe, Pb and Zn results for all sites close to IVACO with the corresponding May to November 1986 results. The July to November data for 1986 and 1991 have also been summarized for these elements so comparisons could be made with 1987 (see Table 17). These tables show that, in comparison to 1986 and 1987, the six-month (May-November) and four-month (July-November) means for Cr,

Cu, Fe and Pb were lower in 1991. Cr and Fe showed the greatest reduction, with the 1991 six-month Cr and Fe means for sites close to IVACO, on average, being about 40 to 55% lower than 1986. The 1991 four-month Cr and Fe means, on average, were 50 to 55% lower than 1986 and 1987 (see Figures 1 to 4). Tables 16 and 17 also show that the ULN guidelines for Cr, Cu, Fe and Pb were exceeded on fewer occasions in 1991. For example, in previous years, the six-month and four-month Cr and Fe means were above the respective ULN guidelines at most sites. In 1991, the Cr and Fe ULNs were not exceeded at any sites. On average, mean Zn concentrations and number of exceedances increased marginally in 1987 and declined in 1991 to levels that were comparable to 1986. These results further indicate that, overall, metal emissions from IVACO were reduced in 1991.

Moss Bag Results for Mn, Mo, Na, Sr, V

As ULN guidelines for these metals have not been established, the results were compared with the data collected from remote sites. Moss bag concentrations of Mn were generally higher at sites close to IVACO, with the six-month means showing a similar pattern, indicating that IVACO is likely a source of Mn. However, even the highest six-month Mn means of 257 and 263 ppm (Sites 1 and 3) were just marginally higher than the remote site means (range 174-215 ppm), indicating that IVACO emissions of Mn were minor during the May through November study period. Mo, Na, Sr and V concentrations were either lower or no different, on average, at the sites close to IVACO compared to the more remote sample sites. Therefore, IVACO is not likely a source of these metals.

Maple Foliage Results

Table 18 shows the metal concentrations that accumulated in maple foliage during the growing season through to mid-August (1991). In the previous report (ARB-114-88-Phyto), the foliar site numbers corresponded with the moss bag sites. In this report, the foliage site numbers have been changed to correspond with the soil sites that were sampled in 1987 or earlier, as the tree foliage samples were collected from the same property or general area as the soil samples.

In Table 18, the foliage results are compared with both the rural and the urban ULNs. A rural ULN has not been established for Mn. No ULNs have been established for Sr.

The highest foliar concentrations of most metals were detected at Site 11, which is situated near the main entrance to IVACO. At this site, foliar concentrations of Fe (535 ppm) were slightly greater than the rural ULN (500 ppm). The concentration of Mn at Site 11 (165 ppm), as well as at Site 12 (145 ppm), was marginally elevated compared with the urban ULN (100 ppm). Foliar concentrations of Na were marginally above the 50 ppm rural ULN at Sites 6 (56 ppm) and 9 (66 ppm).

At Site 11, foliar concentrations of Cd, Cr, Cu, Pb, and Zn also were generally higher than

at other sites, but concentrations of these metals were below the rural ULNs. Foliar concentrations of Sr also were higher at Sites 6 and 9 than at other sites. Sr may be naturally higher in Manitoba Maple foliage than in other maples. The Sr in soil at Site 9 may also have contributed to the foliar elevation at this site (Table 20). As both Na and Sr foliar concentrations were relatively low at Site 11 (where other metals were elevated), and as the moss bag data indicated that IVACO emissions of Na and Sr were insignificant in 1991, IVACO was not likely the source of the Na and Sr at Sites 6 and 9. Regardless, the foliar Na and Sr concentrations at these sites were not unusually elevated above normal.

In Table 19, the maple foliage results are compared with the corresponding previous year's results. Though concentrations of a few metals (e.g. Zn) at some sites increased marginally through to 1991, foliar concentrations of most elements in 1991 (including Fe) were amongst the lowest to be detected since foliage sampling began in 1980. The rural ULN for Fe was exceeded only at one site in 1991 compared to three sites in 1986 and 1984 and two sites in 1983 and 1980. The other elements that exceeded the ULNs in 1991 (Mn, Na) were not analyzed in previous years and were not likely associated with IVACO emissions. At the sites with a reduction in Fe levels in 1991 (Sites 1, 6, 9, 11 and 19), Fe levels were lower (on average) by 35% compared to 1986. At sites where Cr decreased, Cr levels were lower by 46% from 1986. These results corroborated the reduction in Cr and Fe levels in the moss bags and further indicate that IVACO metal emissions were reduced in 1991.

Soil Results

Table 20 shows that soil concentrations of most metals were highest at Site 1 (to N), Site 11 (to S), and/or Site 12 (to N) in the area of IVACO. The soil metal concentrations shown below exceeded the rural ULNs.

Site 1 - Cr 115 ppm; Fe 39500; V 87 ppm; Mn 725 ppm; Cu 65 ppm; Ni 62 ppm;
Site 11 - Cr 110 ppm; Fe 36000; V 84 ppm; Mn 840 ppm;
Site 12 - Cr 110 ppm; Fe 36000; V 77 ppm
Site 8 - Cr 51 ppm
Site 8a - Cr 82 ppm
Site 19 - Cr 53 ppm

The Cu, Fe, Mn, Ni and V exceedances were marginal compared to the rural ULNs (Cu 60 ppm, Fe 35000, Mn 700 ppm, Ni 60 ppm, V 70 ppm). The Cr ULN was exceeded at six of the eleven sampling sites, including remote Sites 8 and 8a. The highest Cr levels of 110 to 115 ppm were more than double the rural ULN (50 ppm). The fact that soil Cr levels greater than the 50 ppm ULN also were found at two of the four remote sites sampled in 1987, and at the original control site in 1980 (66 ppm), suggests that background Cr levels in the area may be naturally elevated. However, because the higher Cr concentrations were close to IVACO, it is suspected that IVACO has contributed

to the elevated soil Cr levels found in the area.

Soil concentrations of Al, Na and Sr, for which ULN guidelines have not been established, also appeared elevated at sites close to IVACO. In the immediate area of IVACO, the highest soil concentrations of Al and Na were found at Sites 1, 11 and 12, where the highest soil concentrations of other metals were detected. This pattern implicates IVACO as a contributor. However, Al also was elevated at remote park Site 8a (36500 ppm), which suggests that some soils in the area are naturally high in Al. The concentration of Al in soil is highly variable, depending on soil characteristics (e.g clay content), with the normal range for Ontario parkland soils being 4000 to 36000 ppm. Compared with this range, the soil concentrations of Al at Sites 1 and 12 (37500 and 39500 ppm), to the north of IVACO, appear to be marginally above normal. The normal range for Na in Ontario parkland soils is 23 to 1600 ppm, and for Sr is 7 to 145 ppm. Compared with these values, even the highest Na soil concentration in the survey area (635 ppm - Site 1) is well within a normal range. The highest soil value for Sr (150 ppm - Site 9) is very close to normal.

In Table 20, the soil results are compared to the MOE soil clean-up or decommissioning guidelines. Soil decommissioning guidelines have not been established for Al, Fe, Mn, Na and Sr. These clean-up levels were developed for the decommissioning of industrial-commercial land for residential and park use. Soil concentrations below these guidelines would not be expected to be phytotoxic or pose any threat to animal or human health. In relation to these guidelines, even the highest soil concentrations of Cd, Cr, Co, Cu, Pb, Mo, Ni, V and Zn are low and of no immediate concern.

The soil results for 1991 are compared with the corresponding previous survey results in Table 21. This table shows that soil metal concentrations in the survey area generally have increased since 1980. The largest increase, overall, occurred at Site 1, which is located just north of IVACO. At this site, soil concentrations of Cr, Cu, Fe, Ni and V, which were below the rural ULNs in most previous years, are marginally above the ULNs in 1991. Soil concentrations of Cd at Sites 1 and 12 appeared notably higher because of the low values in previous years. In spite of the Cd increase at some sites, even the highest concentrations (1.5 - 2 ppm) were within a normal range (< 3 ppm) in 1991.

Summary

In summary, the moss bag survey revealed that IVACO operations during May to November 1991 were a source of Cr, Cu, Fe, Pb and Zn emissions. At moss sites close to IVACO, Fe showed the greatest increase, on average, above the remote site and baseline means. In spite of this, there was only a single exceedance of the rural Fe ULN. The moss bag data suggested that IVACO was a more consistent source of Cu, Pb and Zn (particularly Zn) than of other metals, based on the number of exceedances of the rural ULNs. In relation to the urban ULNs, only a few Cr results were marginally elevated. In tree foliage, only the rural ULNs for Fe and Na, and the urban ULN for Mn (no rural ULN

established), were marginally exceeded at a few sites. The moss/foliage results indicated that IVACO metal emissions during the six month study period were minor in regards to their impact on the terrestrial environment. Compared to previous years, metal concentrations in moss bags and tree foliage were decreased overall, indicating that IVACO metal emissions were lower in 1991.

Overall, metal concentrations in surface soil have increased marginally from the initial 1980 data. Soil concentrations of Cr, Cu, Fe, Mn, Ni and V at a few sites exceeded the rural ULNs in 1991. However, adverse effects would not be anticipated as even the highest soil concentrations of these metals were only marginally higher than the rural ULNs and/or were well below the effects-based MOE soil decommissioning guidelines.

Table 2: Aluminum Concentrations (ppm) In Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary			
	1	2	3	4	5	6	Min	Max	Mean	E*
Moss Bag Sites Close to IVACO (<1000 m)										
1	980	850	820	990	880	830	820	990	892	0
2	730	760	830	820	850	780	730	850	795	0
3	810	900	940	930	950	960	810	960	915	0
7	850	710	820	1100	930	1100	710	1100	918	0
8	590	690	710	860	1100	1000	590	1100	825	0
9	710	1000	770	850	990	NS	710	1000	864	0
12	630	930	780	930	1300	980	630	1300	925	0
Sites More Remote (>1750 m)										
4	690	800	840	870	1000	780	690	1000	830	0
5	1200	700	890	840	1100	750	700	1200	913	0
6	1200	NS	880	1100	870	870	870	1200	984	0
10	560	790	820	790	1100	1100	560	1100	860	0
11	640	1000	780	1000	970	800	640	1000	865	0
Blank	590	850	700	850	810	NS	590	850	760	0

* Number of times rural ULN (1700 ppm) exceeded. NS- No sample received

Table 3: Cadmium Concentrations (ppm) In Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary			
	1	2	3	4	5	6	Min	Max	Mean	E*
Moss Bag Sites Close to IVACO (<1000 m)										
1	0.5	0.4	0.4	0.7	0.3	0.3	0.3	0.7	0.4	0
2	0.5	0.5	0.3	0.5	0.5	0.4	0.3	0.5	0.5	0
3	0.4	1.4	0.5	0.6	0.4	0.3	0.3	1.4	0.6	0
7	0.3	0.4	0.3	0.4	0.3	0.4	0.3	0.4	0.4	0
8	0.3	0.5	0.3	0.4	0.5	0.4	0.3	0.5	0.4	0
9	0.3	0.2	0.6	0.4	0.7	NS	0.2	0.7	0.4	0
12	0.8	0.3	0.4	0.3	0.5	0.4	0.3	0.8	0.5	0
Sites More Remote (>1750 m)										
4	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0
5	0.2	0.4	0.3	0.4	0.5	0.4	0.2	0.5	0.4	0
6	0.1	NS	0.3	0.3	0.5	0.2	0.1	0.5	0.3	0
10	0.2	0.2	0.3	0.2	0.6	0.3	0.2	0.6	0.3	0
11	0.3	0.3	0.2	0.3	0.4	0.3	0.2	0.4	0.3	0
Blank	0.3	0.3	0.2	0.3	0.2	NS	0.2	0.3	0.3	0

* Number of times rural ULN (2 ppm) exceeded. NS- no sample received

Table 4: Chromium Concentrations (ppm) In Moss Baga: May-November, 1991

Site	Exposure Period No.						Data Summary			
	1	2	3	4	5	6	Min	Max	Mean	E*
Moss Bag Sites Close to IVACO (<1000 m)										
1	5	4	5	10	4	4	4	10	5	1
2	4	2	3	6	4	3	2	6	4	0
3	4	11	5	7	4	5	4	11	6	1
7	5	2	4	8	4	4	2	8	5	1
8	2	3	3	4	5	5	2	5	4	0
9	3	5	4	6	5	NS	3	6	4	0
12	5	5	7	5	7	3	3	7	5	0
Sites More Remote (>1750 m)										
4	1	2	2	3	3	3	1	3	2	0
5	3	2	3	4	4	3	2	4	3	0
6	2	NS	2	4	2	2	2	4	2	0
10	2	3	2	3	3	3	2	3	3	0
11	2	4	2	4	2	2	2	4	3	0
Blank	1	2	2	2	3	NS	1	3	2	0

* Number of times urban ULN (7 ppm) exceeded. Rural ULN not established
NS - no sample received

Table 5: Cobalt Concentrations (ppm) In Moss Baga: May-November, 1991

Site	Exposure Period No.						Data Summary			
	1	2	3	4	5	6	Min	Max	Mean	E*
Moss Bag Sites Close to IVACO (<1000 m)										
1	0.9	0.7	0.4	0.8	0.5	0.7	0.4	0.9	0.7	0
2	0.6	0.5	0.4	0.5	0.6	0.5	0.4	0.6	0.5	0
3	0.6	0.7	0.4	0.7	0.7	0.5	0.4	0.7	0.6	0
7	0.9	0.5	0.4	0.8	0.6	0.8	0.4	0.9	0.7	0
8	0.7	0.4	0.4	0.7	0.6	0.6	0.4	0.7	0.6	0
9	0.7	0.9	0.9	1.1	0.9	NS	0.7	1.1	0.9	0
12	0.6	0.7	0.6	0.7	0.7	0.5	0.5	0.7	0.6	0
Sites More Remote (>1750 m)										
4	0.6	0.4	0.3	0.6	0.6	0.4	0.3	0.6	0.5	0
5	0.9	0.5	0.7	0.6	0.7	0.5	0.5	0.9	0.7	0
6	0.7	NS	0.5	0.7	0.7	0.4	0.4	0.7	0.6	0
10	0.4	0.6	0.4	0.6	0.7	0.6	0.4	0.7	0.6	0
11	0.5	0.7	0.5	0.7	0.6	0.4	0.4	0.7	0.6	0
Blank	0.6	0.6	0.4	0.6	0.4	NS	0.4	0.6	0.5	0

* Number of times urban ULN (6 ppm) exceeded. Rural ULN not established
NS - no sample received

Table 6: Copper Concentrations (ppm) in Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary			
	1	2	3	4	5	6	Min	Max	Mean	E*
Moss Bag Sites Close to IVACO (<1000 m)										
1	8	6	6	10	5	5	5	10	7	1
2	7	5	4	7	5	5	4	7	5	0
3	6	14	7	9	5	5	5	14	8	2
7	8	23	8	10	6	5	5	23	10	2
8	5	7	6	6	5	5	5	7	6	0
9	9	17	20	16	16	NS	9	20	16	5
12	11	6	12	6	9	5	5	12	8	3
Sites More Remote (>1750 m)										
4	5	4	5	5	4	5	4	5	5	0
5	6	5	6	7	5	5	5	7	6	0
6	6	NS	5	14	8	5	5	14	7	1
10	8	15	7	15	7	7	7	15	10	2
11	5	6	5	6	5	4	4	6	5	0
Blank	5	4	5	4	4	NS	4	5	4	0

* Number of times rural ULN (8 ppm) exceeded. NS- no sample received

Table 7: Iron Concentrations (ppm) in Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary			
	1	2	3	4	5	6	Min	Max	Mean	E*
Moss Bag Sites Close to IVACO (<1000 m)										
1	1600	1200	1100	1700	1000	1100	1000	1700	1283	0
2	1400	860	790	1100	1200	880	790	1400	1038	0
3	1200	2200	1200	1500	1100	1100	1100	2200	1383	1
7	1200	880	970	1400	1000	1200	880	1400	1108	0
8	950	1000	880	900	1200	1000	880	1200	988	0
9	980	1200	880	1200	1400	NS	880	1400	1132	0
12	1300	1100	1300	1100	1600	1100	1100	1600	1250	0
Sites More Remote (>1750 m)										
4	900	880	880	870	920	870	870	920	887	0
5	1300	1000	1100	1100	1100	930	930	1300	1088	0
6	1100	NS	790	1000	900	880	790	1100	934	0
10	840	840	760	840	1100	1000	760	1100	897	0
11	870	1000	750	1000	910	830	750	1000	893	0
Blank	820	740	650	740	750	NS	650	820	740	0

* Number of times rural ULN (1700 ppm) exceeded. NS - no sample received

Table 8: Lead Concentrations (ppm) in Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary			
	1	2	3	4	5	6	Min	Max	Mean	E*
Moss Bag Sites Close to IVACO (<1000 m)										
1	33	31	34	51	23	26	23	51	33	1
2	33	34	26	38	36	22	22	38	32	2
3	28	79	38	40	31	27	27	79	41	3
7	20	32	23	37	24	27	20	37	27	1
8	13	33	30	30	27	24	13	33	26	0
9	19	38	40	39	41	NS	19	41	35	4
12	39	30	33	30	43	31	30	43	34	2
Sites More Remote (>1750 m)										
4	14	21	23	27	23	24	14	27	22	0
5	16	33	26	33	31	33	16	33	29	0
6	18	NS	26	31	36	20	18	36	26	1
10	17	29	27	29	37	22	17	37	27	1
11	18	29	31	29	27	25	18	31	27	0
Blank	17	24	26	24	27	NS	17	27	24	0

* Number of times rural ULN (35 ppm) exceeded. NS - no sample received

Table 9: Manganese Concentrations (ppm) in Moas Bags: May-November, 1991

Site	Exposure Period No.						Data Summary*			
	1	2	3	4	5	6	Min	Max	Mean	
Moss Bag Sites Close to IVACO (<1000 m)										
1	330	280	230	370	170	160	160	370	257	
2	300	280	190	280	190	130	130	300	228	
3	260	440	240	310	180	150	150	440	263	
7	270	250	230	300	200	130	130	300	230	
8	250	290	220	270	250	150	150	290	238	
9	270	280	200	270	200	NS	200	280	244	
12	300	270	280	270	190	120	120	300	238	
Sites More Remote (>1750 m)										
4	250	230	190	250	150	160	150	250	205	
5	260	280	200	260	170	120	120	280	215	
6	220	NS	170	220	130	130	130	220	174	
10	240	220	190	220	120	170	120	240	193	
11	250	260	180	260	180	140	140	260	212	
Blank	220	210	240	210	240	NS	210	240	224	

* ULN guidelines not established. NS - no sample received

Table 10: Molybdenum Concentrations (ppm) In Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary*		
	1	2	3	4	5	6	Min	Max	Mean
Moss Bag Sites Close to IVACO (<1000 m)									
1	0.5	0.4	0.6	0.7	0.4	0.3	0.3	0.7	0.5
2	0.3	0.2	0.2	0.4	0.3	0.2	0.2	0.4	0.3
3	0.2	0.3	0.3	0.5	0.2	0.3	0.2	0.5	0.3
7	0.4	0.3	0.2	0.4	0.2	0.2	0.2	0.4	0.3
8	0.2	0.2	0.4	0.6	0.2	0.2	0.2	0.6	0.3
9	0.2	0.2	0.7	0.3	0.5	NS	0.2	0.7	0.4
12	0.6	0.3	0.2	0.3	0.2	0.4	0.2	0.6	0.3
Sites More Remote (>1750 m)									
4	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.3
5	0.2	0.2	0.2	0.4	0.2	0.2	0.2	0.4	0.2
6	0.2	NS	0.7	0.7	0.2	0.2	0.2	0.7	0.4
10	0.2	0.4	0.3	0.4	0.4	0.2	0.2	0.4	0.3
11	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Blank	0.2	0.4	0.2	0.4	0.2	NS	0.2	0.4	0.3

* ULN guidelines not established. NS- no sample received

Table 11: Nickel Concentrations (ppm) In Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary			
	1	2	3	4	5	6	Min	Max	Mean	E*
Moss Bag Sites Close to IVACO (<1000 m)										
1	4	3	4	4	3	3	3	4	3	0
2	3	3	4	3	3	3	3	4	3	0
3	3	4	5	4	3	3	3	5	4	0
7	4	3	3	4	3	3	3	4	3	0
8	4	3	3	3	4	3	3	4	3	0
9	3	3	4	3	4	NS	3	4	4	0
12	4	3	5	3	4	3	3	5	4	0
Sites More Remote (>1750 m)										
4	3	7	4	3	3	3	3	7	4	1
5	4	3	4	4	4	3	3	4	4	0
6	3	NS	4	4	3	3	3	4	4	0
10	3	3	4	3	3	3	3	4	3	0
11	3	3	3	3	3	3	3	3	3	0
Blank	3	3	4	3	3	NS	3	4	3	0

* Number of times rural ULN (6 ppm) exceeded. NS - no sample received

Table 12: Sodium Concentrations (ppm) In Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary*		
	1	2	3	4	5	6	Min	Max	Mean
Moss Bag Sites Close to IVACO (<1000 m)									
1	72	240	150	160	130	150	72	240	150
2	270	130	130	240	68	130	68	270	161
3	240	460	140	300	130	220	130	460	248
7	250	160	130	140	140	230	130	250	175
8	250	110	89	280	160	230	89	280	187
9	400	130	84	82	71	NS	71	400	153
12	280	130	150	130	82	130	82	280	150
Sites More Remote (>1750 m)									
4	380	190	150	250	120	140	120	380	205
5	260	94	150	170	81	120	81	260	146
6	340	NS	140	540	75	180	75	540	255
10	180	84	200	84	120	160	84	200	138
11	230	270	280	270	110	130	110	280	215
Blank	280	160	260	160	300	NS	160	300	232

* ULN guidelines not established. NS - no sample received

Table 13: Strontium Concentrations (ppm) In Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary*		
	1	2	3	4	5	6	Min	Max	Mean
Moss Bag Sites Close to IVACO (<1000 m)									
1	25	16	14	16	14	13	13	25	16
2	22	9	10	15	15	14	9	22	14
3	19	21	14	21	17	17	14	21	18
7	18	12	11	15	16	12	11	18	14
8	19	9	11	12	13	12	9	19	13
9	22	15	13	16	18	NS	13	22	17
12	20	12	15	12	19	15	12	20	16
Sites More Remote (>1750 m)									
4	20	10	9	12	13	15	9	20	13
5	29	16	20	22	20	15	15	29	20
6	33	NS	16	38	27	21	16	38	27
10	20	11	8	11	18	11	8	20	13
11	21	14	10	14	15	12	10	21	14
Blank	13	11	7	11	7	NS	7	13	10

* ULN guidelines not established. NS - no sample received

Table 14: Vanadium Concentrations (ppm) in Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary*		
	1	2	3	4	5	6	Min	Max	Mean
Moss Bag Sites Close to IVACO (<1000 m)									
1	5	5	5	6	5	5	5	6	5
2	4	5	5	5	5	5	4	5	5
3	4	6	6	5	6	5	4	6	5
7	4	4	5	6	5	6	4	6	5
8	2	5	5	5	6	6	2	6	5
9	2	6	4	5	6	NS	2	6	5
12	2	5	5	5	7	5	2	7	5
Sites More Remote (>1750 m)									
4	2	5	5	5	5	5	2	5	5
5	3	4	5	5	5	5	3	5	5
6	5	NS	5	5	5	5	5	5	5
10	2	5	5	5	6	5	2	6	5
11	2	5	5	5	5	5	2	5	5
Blank	2	5	5	5	5	NS	2	5	4

* ULN guidelines not established. NS - no sample received

Table 15: Zinc Concentrations (ppm) in Moss Bags: May-November, 1991

Site	Exposure Period No.						Data Summary		
	1	2	3	4	5	6	Min	Max	Mean
Moss Bag Sites Close to IVACO (<1000 m)									
1	230	110	130	440	110	110	110	440	188
2	230	87	75	250	99	85	75	250	138
3	170	760	270	240	100	100	100	760	273
7	91	94	59	110	77	94	59	110	88
8	81	75	58	53	66	57	53	81	65
9	150	130	110	150	180	NS	110	180	144
12	440	130	210	130	200	110	110	440	203
Sites More Remote (>1750 m)									
4	83	50	52	70	49	58	49	83	60
5	96	54	62	69	84	52	52	96	70
6	47	NS	39	60	57	45	39	60	50
10	89	80	55	80	90	62	55	90	76
11	96	97	60	97	50	54	50	97	76
Blank	65	39	32	39	34	NS	32	65	42

* Number of times rural ULN (100 ppm) exceeded. NS - no sample received

Table 16: Comparison of Concentrations of Selected Metals in Moss Bags Exposed in the Vicinity of IVACO In 1986 and 1991.

Site	Range(R) Mean(M) and Exceedances(E)	Element and Concentration - parts per million, dry weight									
		Chromium			Copper			Iron			Lead
1986	1991	1986	1991	1986	1991	1986	1991	1986	1991	1986	1991
1	R M E	5-13 10 (5)	4-10 5 (1)	7-9 8 3	5-10 7 1	1600-2000 1850 5	1000-1700 1283 0	26-55 42 5	23-51 33 1	100-170 142 5	110-440 188 6
2	R M E	6-9 7 (3)	2-6 4 (0)	6-10 8 2	4-7 5 0	1200-2100 1566 2	790-1400 1038 0	28-62 41 4	22-38 32 2	76-270 178 5	75-250 138 2
3	R M E	5-22 12 (5)	4-11 6 (2)	5-13 9 3	5-14 8 2	1300-3700 2117 3(1)	1100-2200 1383 1	30-67 48 5	27-79 41 3	53-370 174 4	100-780 273 4
7	R M E	4-24 13 (5)	2-8 5 (1)	7-21 12 4	5-23 10 4	1300-3000 2017 4	880-1400 1108 0	33-58 43 4	20-37 27 1	70-210 115 3	59-110 88 1
8	R M E	6-15 9 (3)	2-5 4 (0)	5-9 7 2	5-7 6 0	1200-1700 1433 0	880-1200 988 0	20-42 33 3	13-33 26 0	59-91 69 0	53-81 65 0
9	R M E	9-19 16 (6)	3-6 4 (0)	12-40 21 6	9-20 16 5	2200-3200 2717 6(2)	880-1400 1132 0	40-71 56 6	19-41 35 4	120-270 198 6	110-180 144 5
12	R M E	6-15 9 (3)	3-7 5 (1)	5-17 9 2	5-12 8 3	1100-2400 1667 2	1100-1600 1250 0	32-59 41 3	30-43 34 2	61-180 1156 4	110-440 203 6
Rural ULN*		NG	8	8	8	1700	3000	35	35	100	800
Urban ULN*		7	60	60	60	200		200			

* Phytotoxicology Section Upper Limit of Normal (ULN) moss bag guidelines, see appendix

NG - ULN guideline not established

E - Number of occasions moss concentration exceeded ULN for a rural area and/or (urban area)

Table 17: Comparison of 1991 July to November Moss Bag Cr, Fe, and Zn Results for Sites Close to IVACO with Corresponding 1986 and 1987 Results

Site	Range(R) Mean(M) Exceeds(E)	Chromium						Iron						Zinc					
		1988			1987			1991			1988			1987			1991		
		1988	1987	1991	1988	1987	1991	1988	1987	1991	1988	1987	1991	1988	1987	1991			
1	R M E	5-12 9 3	9-17 12 4	4-10 6 1	1600-2000 1850 3	1400-2800 2100 3	1000-1700 1225 0	100-160 133 3	110-270 210 4	110-440 198 4	110-270 210 4	110-270 210 4	110-440 198 4	110-270 210 4	110-270 210 4	110-440 198 4			
2	R M E	6-9 7 1	5-15 9 3	3-6 4 0	1200-2100 1700 2	1400-2400 1775 2	790-1200 993 0	76-270 182 3	100-340 200 3	75-250 127 1									
3	R M E	5-22 11 3	8-23 16 4	4-7 5 1	1300-3700 2150 2(1)	1800-3500 2750 4(2)	1100-1500 1225 0	53-370 164 2	110-460 363 4	100-270 178 2									
7	R M E	4-16 11 3	6-12 10 3	4-8 5 1	1400-2200 1950 3	1700-2100 1975 3	970-1400 1142 0	94-110 102 2	85-180 124 2	59-110 68 0									
8	R M E	6-8 7 1	4-11 7 1	3-5 4 0	1200-1500 1350 0	1200-2000 1575 1	880-1200 995 0	59-91 69 0	49-76 68 0	53-66 59 0									
9	R M E	9-17 15 4	6-14 9 2	4-6 5 0	2200-3100 2525 4(1)	1100-2400 1725 2	880-1400 1160 0	120-270 193 4	110-320 188 4	110-180 147 3									
12	R M E	6-9 7 1	ND ND ND	3-7 6 1	1100-2100 1600 1	ND ND ND	1100-1600 1275 0	61-170 113 3	ND ND ND	110-210 163 4									
Rural ULN* Urban ULN*		NG 7						1700 3000						100 800					

- Phytotoxicology Section Upper Limit of Normal (ULN) moss bag guidelines, see appendix
- NG - ULN not established
- E - Number of occasions moss concentration exceeded ULN for a rural area and/or (urban area)
- ND - No data

Table 17 Con'd: Comparison of 1991 July to November Moss Bag Cu and Pb Results for Sites Close to IVACO Compared with Corresponding 1986 and 1987 Results

Site	Range(R) Mean(M) Exceeds(E)	Element and Concentration - Parts per million, dry weight					
		Copper			Lead		
		1986	1987	1991	1986	1987	1991
1	R M E	7.9 8 2	7.11 9 2	5.10 7 1	36.55 45 4	31.57 45 3	23.51 34 1
2	R M E	6.10 8 1	6.11 8 1	3.6 4 0	36.62 46 4	27.52 38 2	22.38 31 2
3	R M E	5.13 8 2	9.15 12 4	5.9 7 1	30.67 47 3	38.74 61 4	27.40 34 2
7	R M E	7.21 12 3	7.17 12 3	5.10 7 2	35.58 44 3	28.41 36 2	23.37 28 1
8	R M E	5.9 6 1	6.8 7 0	5.6 5 0	27.42 35 2	30.38 33 1	24.30 28 0
9	R M E	12.40 21 4	7.13 9 2	16.20 17 3	50.71 59 4	23.57 38 2	39.41 40 3
12	R M E	5.17 9 1	ND ND ND	5.12 8 2	32.59 41 2	ND ND ND	30.43 34 1
Rural ULN*						35	
Urban ULN*						200	
		8					
		60					

- Phytotoxicology Section Upper Limit of Normal (ULN) moss bag guidelines, see appendix
- E - Number of occasions moss concentration exceeded ULN for a rural area and/or (urban area)
- ND - No data

Table 18: Metal Concentrations In Tree Foliage In Area of IVACO: August 20, 1991

Site No./ Direction	Maple Species	Element and Average ^a Concentration (ppm, dry wt.)													
		Al	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Ns	Sr	V	Zn
4 (W)	Silver	37	0.2	1	<0.2	5	160	4	64	0.5	<1	21	24	<0.5	57
19 (NW)	Silver	67	0.1	1	<0.2	10	225	2	54	<0.2	1	22	23	<0.5	44
1 (N)	Sugar	83	0.1	2	0.2	4	290	4	26	0.4	2	16	30	<0.5	34
12 (N)	Silver	35	0.2	<1	<0.2	4	104	1	<u>145</u>	0.3	1	14	33	<0.5	26
6 (NE)	Manitoba	74	0.1	2	<0.2	6	325	8	40	<0.2	2	<u>56</u>	105	<0.5	92
8 (NE)*	Silver	35	0.1	<1	<0.2	11	135	1	30	0.3	1	12	34	<0.5	44
9 (E)	Manitoba	43	<0.1	1	0.3	5	180	5	31	<0.2	2	<u>66</u>	130	<0.5	55
29 (SE)	Red	115	0.2	3	0.2	10	385	11	37	0.2	2	41	59	0.6	130
10 (SE)	Sugar	45	0.1	<1	<0.2	4	140	3	72	1.0	2	17	49	<0.5	29
11 (S)	Silver	105	0.3	4	<0.2	11	<u>535</u>	20	<u>165</u>	<0.2	2	35	35	0.6	250
Rural ULN**		500	1	8	2	20	500	30	NG	1.5	5	50	NG	5	250
Urban ULN**		500	2	8	2	20	1000	60	100	1.5	7	350	NG	5	

a Average of duplicate sample results. * New site in 1991

** Phytotoxicology Section Upper Limit of Normal guidelines, see appendix
NG Guideline not established. Note: Results underlined exceed rural ULN (in case of Mn, the urban ULN)

Table 19: Comparison of 1991 Maple Foliage Results with Corresponding Previous Survey Results.

Site	Year	Element and Average* Concentration in Unwashed Foliage (ppm, dry wt.)								
		Cd	Cr	Cu	Fe	Pb	Mo	Ni	V	Zn
4(W)	1980	0.4	3	8	550	21	-	<1	-	112
	1981	-	<2	-	265	11	-	-	-	77
	1983	<0.1	2	8	267	7	-	<1	-	73
	1984	0.2	3	7	400	8	<0.5	<1	<1	65
	1991	0.2	1	5	160	4	0.5	<1	<1	57
19(NW)	1986	<0.1	2	10	510	5	<0.5	1	<1	46
	1991	0.1	1	10	225	2	<0.2	1	<1	44
1(N)	1980	0.3	3	5	352	11	-	<1	-	47
	1984	0.2	5	7	765	13	1.5	1	1	45
	1986	0.3	3	5	430	7	1.3	2	<1	33
	1991	0.1	2	4	290	4	0.4	2	<1	34
12(N)	1980	<0.2	<2	7	157	3	-	2	-	48
	1981	-	<2	-	150	3	-	-	-	51
	1983	0.3	2	9	147	4	-	1	-	47
	1984	0.2	2	11	255	4	0.5	<1	<1	41
	1991	0.2	<1	4	104	1	0.3	1	<1	26
6(NE)	1980	0.4	3	7	402	21	-	<1	-	57
	1981	-	<2	-	250	11	-	-	-	31
	1983	0.1	3	8	520	14	-	1	-	57
	1984	0.2	5	8	640	12	0.9	2	<1	35
	1986	0.2	4	7	655	12	1.1	2	<1	68
	1991	0.1	2	6	325	8	<0.2	2	<1	92
9(E)	1980	<0.2	2	5	302	13	-	<1	-	46
	1981	-	<2	-	160	6	-	-	-	27
	1983	<0.1	2	7	217	8	-	<1	-	39
	1984	0.2	3	7	350	8	1.0	<1	<1	44
	1986	0.1	2	5	255	6	0.8	1	<1	41
	1991	<0.1	1	5	180	5	<0.2	2	<1	55
29(SE)	1986	0.2	3	4	325	9	0.8	2	<1	50
	1991	0.2	3	10	385	11	0.2	2	1	130
10(SE)	1980	<0.2	2	6	150	8	-	<1	-	-
	1991	0.1	<1	4	140	3	1.0	2	<1	29
11(S)	1980	0.5	4	9	638	30	-	2	-	118
	1981	-	<2	-	420	17	-	-	-	88
	1983	0.5	4	11	717	38	-	2	-	300
	1984	0.3	4	11	725	21	0.7	<1	<1	115
	1986	0.3	3	8	550	13	0.5	1	<1	93
	1991	0.3	4	11	535	20	<0.2	2	1	250
ULN Guidelines	Rural	1	8	20	500	30	1.5	5	5	250
	Urban	2	8	20	1000	60	1.5	7	5	250

a Average of duplicate sample results in 1984, 1986 and 1991 and of triplicate results in 1980 and 1983.

1981 results are based a single sample collected per site

Note: Results underlined exceed Phytotoxicology Section rural ULN guideline, see appendix

Table 20: Metal Concentrations In Surface Soil In Area of Ivaco: August 20, 1991

Site No./ Direction	Site Description	Average ^a Concentration (ppm, dry wt.)													
		Al	Cd	Cr	Co	Cu	Fe	Pb	Mn	Mo	Ni	Na	Sr	V	Zn
4(W)	Fr lawn	11000	0.4	31	4	12	13500	16	255	<0.2	14	150	19	30	77
19(NW)	Fr lawn	17500	0.6	<u>53</u>	8	25	20000	17	350	<0.2	27	310	41	45	72
1(N)	Fr lawn	37500	1.4	<u>115</u>	21	<u>65</u>	<u>39500</u>	20	<u>725</u>	<0.2	<u>62</u>	635	63	<u>87</u>	130
12(N)	Ball park	39500	1.5	<u>110</u>	17	41	<u>36000</u>	20	540	<0.2	52	335	53	<u>77</u>	120
6(NE)	Bk lawn	14500	0.6	41	7	19	16500	38	370	0.5	20	155	34	37	110
8(NE)	Ball Field Park (8a)*	19000	0.4	<u>51</u>	9	20	22000	13	470	<0.2	25	190	39	48	71
9(E)	Fr lawn	8850	0.6	24	3	16	8600	30	235	<0.2	12	165	150	22	79
29(SE)	Fr lawn	10500	0.6	26	4	13	12000	27	235	<0.2	12	145	25	28	64
10(SE)	Fr lawn	17500	0.6	31	8	20	22500	29	490	<0.2	17	98	22	44	74
11(S)	Fr lawn	32000	2.0	<u>110</u>	18	49	<u>36000</u>	69	<u>840</u>	<0.2	49	305	60	<u>84</u>	270
Rural ULN**		NG	3	50	25	60	35000	150	700	2	60	NG	NG	70	500
Urban ULN**		NG	4	50	25	100	35000	500	700	3	60	NG	NG	70	500
Soil Dec***		NG	4	1000	50	200	NG	500	NG	5	200	NG	NG	250	800

a Average of duplicate sample results. Fr - Front yard; Bk - Backyard

* New Site in 1991. Park soil Site 8a was close to road and maple site (S end of park)

** Phytotoxicology Section Upper Limit of Normal guidelines, see appendix

*** MOE soil decommissioning or clean-up guidelines

NG Guideline not established. Note: Results underlined exceed rural ULN

Table 21: Comparison of 1991 Soil Results with Previous Survey Results

Site	Year	Element and Average ^a Concentration in Soil (ppm, dry wt.)								
		Cd	Cr	Cu	Fe	Pb	Mo	Ni	V	Zn
4(W)	1980	<0.5	16	6	-	12	-	8	-	45
	1984	<0.5	19	6	11000	12	<1	8	19	49
	1987	<0.5	24	8	12000	16	<1	9	26	56
	1991	<0.5	31	12	13500	16	<1	14	30	77
19(NW)	1987	<0.5	52	22	20500	20	<1	23	44	74
	1991	0.6	53	25	20000	17	<1	27	45	72
1(N) (see note re: site in 1987)	1980	<0.5	52	42	-	30	-	33	-	106
	1984	0.5	64	28	25500	32	<1	28	44	95
	1987	<0.5	25	9	12000	21	<1	10	25	46
	1991	1.4	115	65	39500	20	<1	62	87	130
12(N) (see note)	1987	0.6	110	31	38500	17	<1	48	74	98
	1991	1.5	110	41	36000	20	<1	52	77	120
6(NE)	1980	<0.5	25	16	-	25	-	14	-	103
	1984	<0.5	34	15	15000	32	<1	15	28	80
	1987	0.5	41	15	16000	36	<1	17	34	91
	1991	0.6	41	19	16500	38	<1	20	37	110
8(NE)	1980	<0.5	32	16	-	16	-	17	-	61
	1984	<0.5	37	12	18500	15	<1	16	33	57
	1987	0.5	60	20	23500	22	<1	25	50	74
	1991	<0.5	51	20	22000	13	<1	25	48	71
9(E)	1980	<0.5	20	12	-	13	-	7	-	38
	1984	<0.5	21	13	9150	25	<1	8	17	57
	1987	<0.5	24	13	8150	24	<1	8	21	51
	1991	0.6	24	16	8600	30	<1	12	22	79
29(SE)	1987	<0.5	27	14	13500	34	<1	11	28	71
	1991	0.6	26	13	12000	27	<1	12	28	64
10(SE)	1980	<0.5	24	17	-	30	-	12	-	65
	1984	<0.5	20	15	16000	33	<1	11	27	62
	1987	0.5	33	17	22000	37	<1	14	39	69
	1991	0.6	31	20	22500	29	<1	17	44	74
11(S)	1980	<1.0	78	53	-	46	-	49	-	160
	1984	1.0	95	30	35000	64	<1	37	66	180
	1987	1.0	110	35	35500	58	<1	44	79	180
	1991	2.0	110	49	36000	69	<1	49	84	270
ULN ^b Guidelines	Rural	3	50	60	35000	150	2	60	70	500
	Urban	4	50	100	35000	500	3	60	70	500
Dec. Guidelines**		4	1000	200	NE	500	5	200	250	800

a. Average of duplicate sample results in 1984, 1987 and 1991 and of triplicate results in 1980

* Upper Limit of Normal (ULN) Guidelines. Results underlined exceed rural ULN. ** MOE soil decommisioning guidelines

Note: Site 1 sampling area in 1987 (front yd) had soil added, which would account for lower levels in 1987. In other years, west side yard was sampled. Site 12 only shows the corresponding data collected from park. The non-corresponding data collected from the original site (residential front lawn) in 1980 and 1984 has been omitted

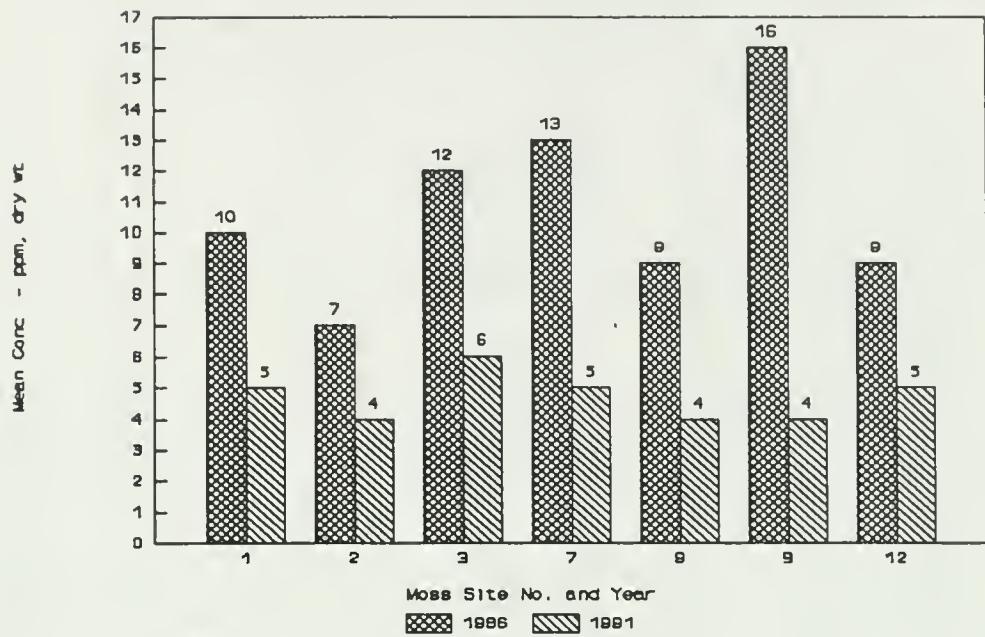


Figure 1: May to November Moss Bag Cr Concentration Means for Sites Close to IVACO Compared with Corresponding 1986 Means

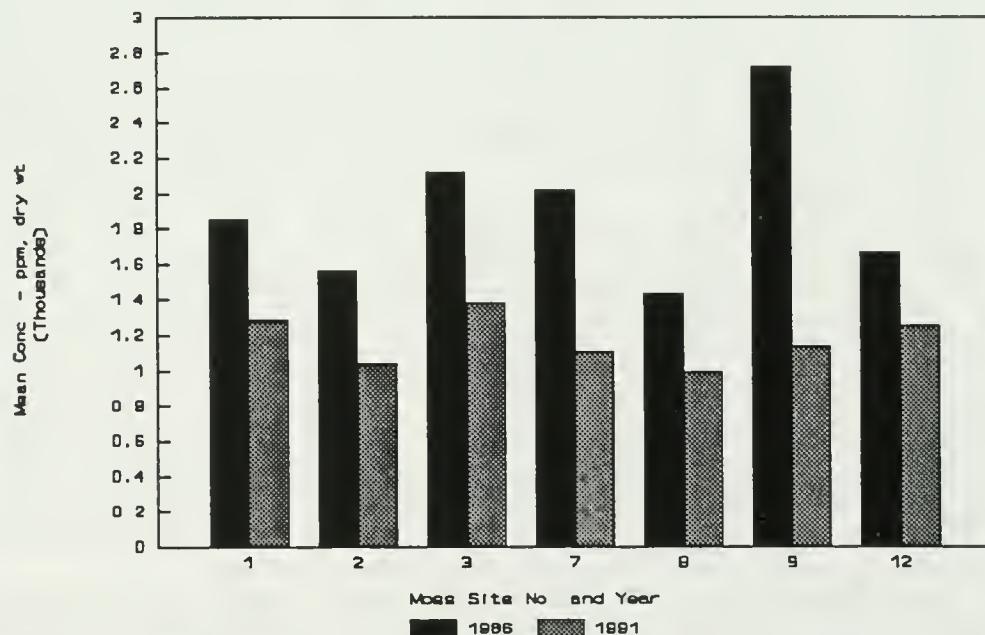


Figure 2: May to November Moss Bag Fe Concentration Means for Sites Close to IVACO Compared with Corresponding 1986 Means

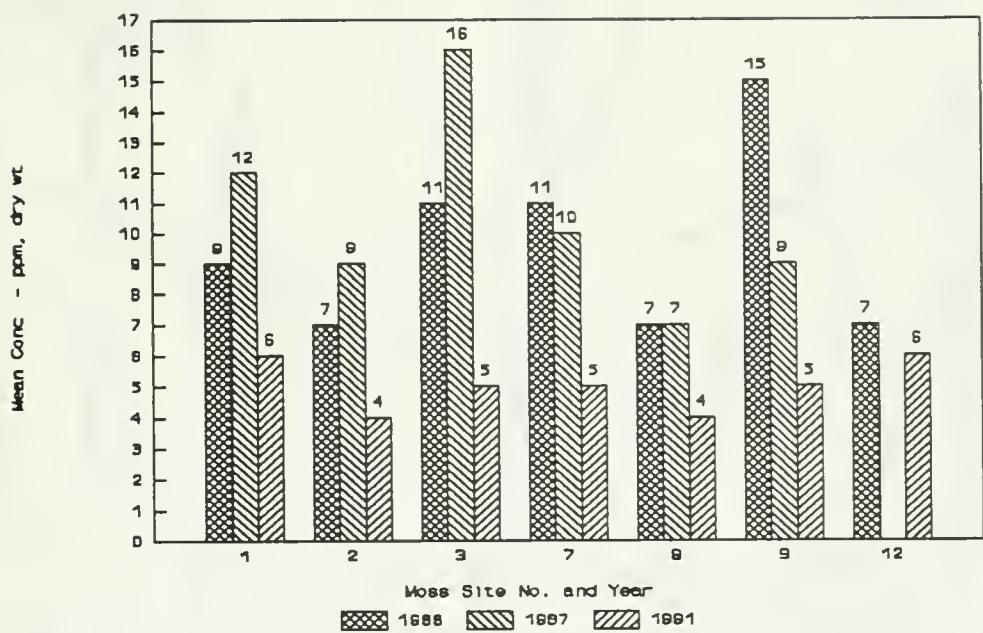


Figure 3: July to November Moss Bag Cr Concentration Means for Sites Close to IVACO Compared with Corresponding 1986 and 1987 Means

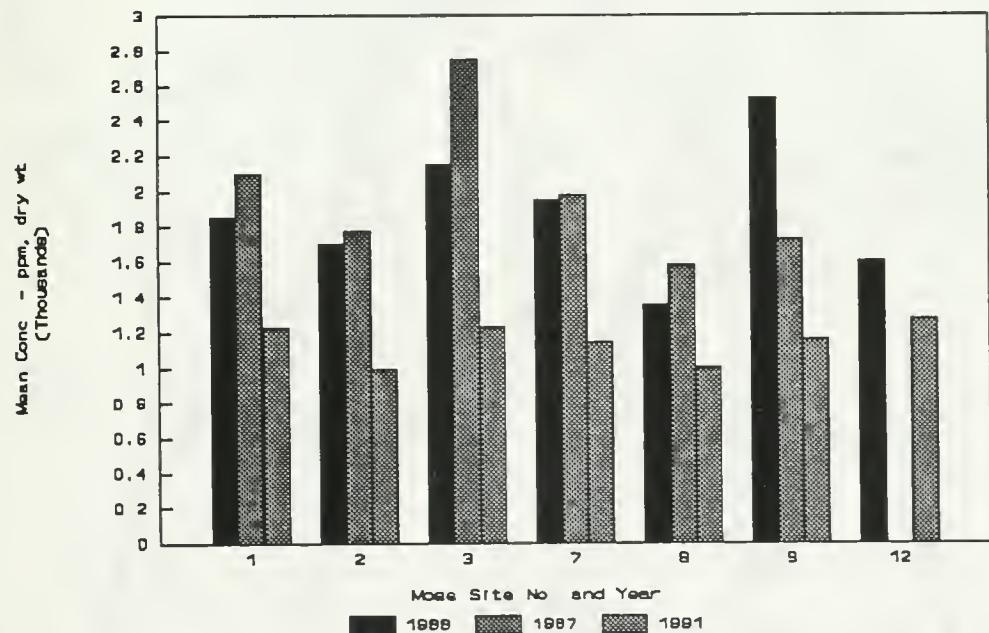


Figure 4: July to November Moss Bag Fe Concentration Means for Sites Close to IVACO Compared with Corresponding 1986 and 1987 Means

Figure 5: Approximate Location of Moss Bag Sites in 1991

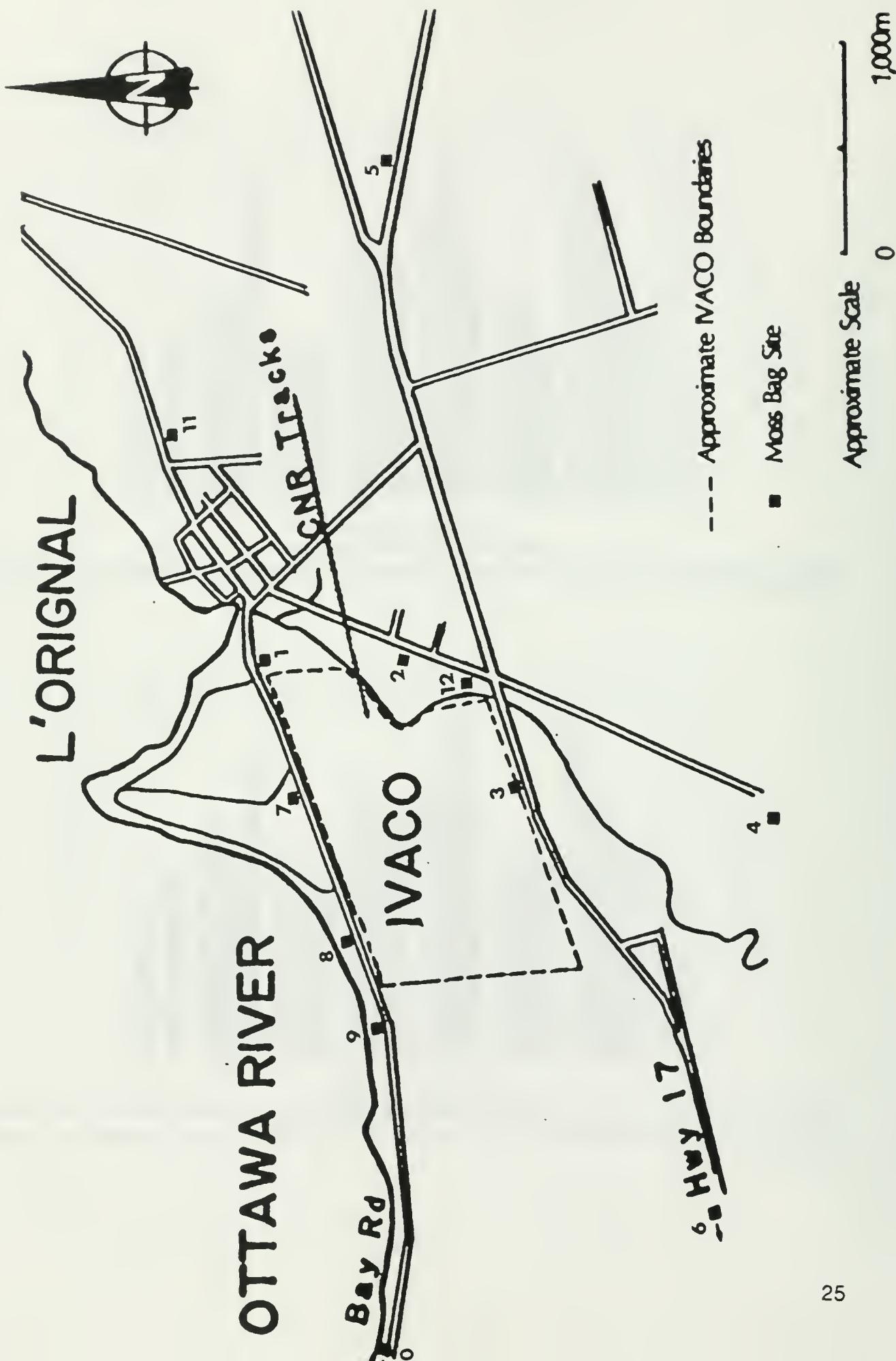


Figure 6: Approximate Location of Foliage and Soil Sites in 1991

